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# PATHOGENS FROM ECONOMICALLY IMPORTANT NITIDULID BEETLES

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# PATHOGENS FROM ECONOMICALLY IMPORTANT NITIDULID BEETLES<sup>1</sup>

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## SUMMARY

One hundred eighteen nitidulid beetle cultures obtained from localities throughout the continental United States, Mexico, and Hawaii were examined for pathogens. An annotated list was compiled to show abundance, distribution, and taxonomic categories of the pathogens found. Of 15 nitidulid species examined, 14 were infected with

protozoans and 5 with nematodes. Four of these pathogens—a sphaerulariid nematode (*Howardula* sp.) and three sporozoans (*Helicosporidium parasiticum* Keilin, *Pleistophora* sp., and a pyriform *Nosema* sp.)—are being studied as possible biological control agents of stored-product insects.

## INTRODUCTION

As part of a 3-year (1967–69) taxonomic study of the larval stages of economically important nitidulid beetles, samples of live beetles were collected and established in laboratory cultures. Samples were obtained from many geographic locations in the continental United States,

Mexico, and Hawaii. Cultures from these collections provided a unique opportunity to investigate associated pathogens. An annotated list was compiled to show the abundance, distribution, and taxonomic categories of the pathogens found.

## MATERIALS AND METHODS

Nitidulids were reared in quart jars one-third filled with a 1:1 mixture of damp sand and peat moss and provided with two autoclaved figs per week. Before examination, each culture was maintained for at least three generations in the same jar to allow possible pathogens to increase and spread through the culture.

A minimum of eight adult beetles were examined from each accession. Specimens were dissected in a 0.65-percent saline solution under 10× magnification, and were subsequently examined under phase contrast at 500 to 1,250×.

## RESULTS AND DISCUSSION

Most of the pathogens observed in this study are undescribed. Those readily identified were determined to the species level; the rest were grouped under higher categories of classification. Pathogens that the authors deemed as having biological control potential have been maintained for further study. In the following annotated list, the nitidulid hosts, their pathogens, and the collec-

tion localities are cited alphabetically. In each citation, the insect host, locality, date, collector, plant host, and pathogens collected are listed in that order. At least one pathogen was present in 86.4 percent of the nitidulid accessions examined. The remaining 13.6 percent negative accessions were cited to indicate the geographical locations sampled.

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<sup>1</sup>This study was made at the Stored-Product Insects Research Laboratory, Western Region, Northern California-Nevada Area, USDA, ARS, Fresno, Calif.

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# NITIDULIDAE

## *Carpophilus corticinus* (Erichson)

1

Locality: Florida, Gainesville, Alachua County  
Date: April 14, 1967  
Collector: G. M. Buxton and F. W. Mead  
Host: Japanese persimmon  
Diagnosis: Cephaline eugregarine.

Collector: G. M. Buxton  
Host: Persimmon  
Diagnosis: Sphaerulariid nematode.

2

## *Carpophilus dimidiatus* (Fabricius)

1

Locality: California, Fresno, Fresno County  
Date: April 3, 1970  
Collector: Laboratory culture  
Host: Cull figs  
Diagnosis: *Farinocystus* sp.

Locality: California, Fresno, Fresno County  
Date: January 18, 1967  
Collector: Laboratory culture  
Host: Figs  
Diagnosis: Haplosporidian in Malpighian tubes;  
*Helicosporidium parasiticum*; *Nosema* sp.  
(ovoid); sphaerulariid nematode.

3

2

Locality: Georgia, Lumpkin, Stewart County  
Date: October 3, 1968, and January 10, 1969  
Collector: J. A. Payne  
Host: Shelled peanuts  
Diagnosis: *Helicosporidium parasiticum* Keilin;  
*Nosema* sp. (ovoid); *Ophryocystis* sp.;  
sphaerulariid nematode.

Locality: Florida, Gainesville, Alachua County  
Date: September 15, 1967  
Collector: G. M. Buxton and D. Habeck  
Host: Squash  
Diagnosis: Cephaline eugregarine; haplosporidian in  
Malpighian tubes; sphaerulariid nematode.

4

3

Locality: Georgia, Newton, Baker County  
Date: October 3, 1968  
Collector: J. A. Payne  
Host: Shelled peanuts  
Diagnosis: *Ophryocystis* sp.

Locality: Georgia, Tifton, Tift County  
Date: June 26, 1968  
Collector: J. A. Payne  
Host: Unknown  
Diagnosis: *Helicosporidium parasiticum*; sphaerulariid  
nematode.

5

4

Locality: Georgia, Tifton, Tift County  
Date: June 3, 1968, and June 26, 1968  
Collector: J. A. Payne  
Host: Fieldcorn and shelled peanuts  
Diagnosis: Cephaline eugregarine; *Helicosporidium*  
*parasiticum*; *Nosema* sp. (ovoid);  
*Ophryocystis* sp.

Locality: Georgia, Tifton, Tift County  
Date: May 25, 1969  
Collector: J. A. Payne  
Host: Apple  
Diagnosis: Haplosporidian in Malpighian tubes.

6

5

Locality: Georgia, Valdosta, Lowndes County  
Date: June 3, 1968  
Collector: J. A. Payne  
Host: Shelled corn  
Diagnosis: Cephaline eugregarine; *Helicosporidium*  
*parasiticum*; *Ophryocystis* sp.

Locality: Hawaii, Pahoehoe, Hawaii County  
Date: May 17, 1968  
Collector: G. T. Okumura  
Host: Papaya  
Diagnosis: No pathogens found.

7

## *Carpophilus freemani* Dobson

1

Locality: Alabama, Auburn, Lee County  
Date: August 25, 1967

Locality: Mississippi, Starkville, Oktibbeha County  
Date: August, 1967  
Collector: G. M. Buxton  
Host: Unknown  
Diagnosis: No pathogens found.

8

Locality: Nevada, Las Vegas, Clark County  
Date: October 4, 1968

Collector: R. C. Bechtel and D. F. Zoller  
Host: Raisins  
Diagnosis: Cephaline eugregarine

9

Locality: Texas, College Station, Brazos County  
Date: August 15, 1968  
Collector: G. M. Buxton  
Host: Figs  
Diagnosis: Cephaline eugregarine; haplosporidian in Malpighian tubes.

10

Locality: Vera Cruz, Tuxpan, Mexico  
Date: October 30, 1967  
Collector: G. T. Okumura  
Host: Unknown  
Diagnosis: Cephaline eugregarine.

*Carpophilus fumatus* Boheman

1

Locality: Florida, Gainesville, Alachua County  
Date: September 14, 1967  
Collector: G. M. Buxton and F. W. Mead  
Host: Tomato  
Diagnosis: No pathogens found.

*Carpophilus hemipterus* (Linnaeus)

1

Locality: California, Fresno, Fresno County  
Date: July 21, 1966, August 5, 1966, and November 30, 1966  
Collector: Laboratory culture  
Host: Figs  
Diagnosis: *Mattesia* sp. (possible *M. grandis*); *Nosema* sp. (ovoid); *Ophryocystis* sp.

2

Locality: Georgia, Tifton, Tift County  
Date: May 25, 1969, and October 20, 1971  
Collector: J. A. Payne  
Host: Raisins  
Diagnosis: *Helicosporidium parasiticum*; *Ophryocystis* sp.; sphaerulariid nematode.

3

Locality: Indiana, Bluffton, Wells County  
Date: August 20, 1967  
Collector: R. F. Wilkey  
Host: Melon  
Diagnosis: *Helicosporidium parasiticum*; *Ophryocystis* sp.

4

Locality: Texas, Calvert, Robertson County

Date: August 23, 1968  
Collector: G. M. Buxton  
Host: Peaches, figs  
Diagnosis: Cephaline eugregarine; *Ophryocystis* sp.

5

Locality: Texas, College Station, Brazos County  
Date: August 15, 1968  
Collector: G. M. Buxton  
Host: Peaches, watermelon  
Diagnosis: Cephaline eugregarine; sphaerulariid nematode.

6

Locality: Texas, Bryan, Brazos County  
Date: August 23, 1968  
Collector: G. M. Buxton  
Host: Peaches  
Diagnosis: *Ophryocystis* sp.

*Carpophilus lugubris* Murray

1

Locality: California, Watts Valley, Fresno County  
Date: October 4, 1968  
Collector: J. Counsilman  
Host: Raisins  
Diagnosis: No pathogens found.

2

Locality: Illinois, Decatur, Macon County  
Date: August 27, 1968  
Collector: W. G. Goodman  
Host: Mulberry tree  
Diagnosis: No pathogens found.

3

Locality: Indiana, Bluffton, Wells County  
Date: August 22, 1967  
Collector: R. F. Wilkey  
Host: Smut cluster on corn stem  
Diagnosis: *Nosema* sp. (pyriform).

4

Locality: Indiana, Vincennes, Knox County  
Date: May 23, 1968  
Collector: T. Mouzin  
Host: Raisins  
Diagnosis: *Nosema* sp. (pyriform).

5

Locality: Maryland, Clarksville, Howard County  
Date: September 19, 1968  
Collector: R. F. Wilkey  
Host: Rotten apples  
Diagnosis: *Nosema* sp. (pyriform).

6

Locality: Maryland, Hancock, Washington County

Date: September 24, 1968  
Collector: R. F. Wilkey  
Host: Apples  
Diagnosis: *Nosema* sp. (pyriform); *Ophryocystis* sp.

7

Locality: Mississippi, Starkville, Oktibbeha County  
Date: September 26, 1967  
Collector: G. M. Buxton  
Host: Tomato  
Diagnosis: Cephaline eugregarine; *Nosema* sp. (pyriform).

8

Locality: Texas, Bryan, Brazos County  
Date: August 23, 1968  
Collector: G. M. Buxton  
Host: Peaches  
Diagnosis: No pathogens found.

*Carpophilus marginellus* Motschulsky

1

Locality: California, Fresno, Fresno County  
Date: September 15, 1966  
Collector: Laboratory culture  
Host: Figs  
Diagnosis: *Nosema* sp. (ovoid).

2

Locality: California, Sacramento, Sacramento County  
Date: May 13, 1970  
Collector: I. E. Savage  
Host: Raisins  
Diagnosis: Cephaline eugregarine.

3

Locality: Hawaii, Paho, Hawaii County  
Date: May 10, 1968  
Collector: G. T. Okumura  
Host: Papaya  
Diagnosis: No pathogens found.

*Carpophilus mutilatus* Erichson

1

Locality: Alabama, Auburn, Lee County  
Date: September 25, 1967  
Collector: G. M. Buxton  
Host: Apples  
Diagnosis: Cephaline eugregarine; *Helicosporidium parasiticum*; *Howardula* sp.; *Ophryocystis* sp.

2

Locality: California, Brawley, Imperial County  
Date: June 3, 1968

Collector: R. A. Flock  
Host: Fruit and flowers  
Diagnosis: *Ophryocystis* sp.

3

Locality: California, Fresno, Fresno County  
Date: January 18, 1967, and February 18, 1971  
Collector: Laboratory culture  
Host: Figs  
Diagnosis: *Howardula* sp.; *Mattesia* sp.; *Nosema* sp. (ovoid); *Nosema* sp. (pyriform); *Ophryocystis* sp.; *Pleistophora* sp.

4

Locality: California, Oildale, Kern County  
Date: March 21, 1968  
Collector: G. M. Buxton and M. Moody  
Host: Orange  
Diagnosis: Haplosporidian in Malpighian tubes; *Helicosporidium parasiticum*; *Ophryocystis* sp.; *Pleistophora* sp.

5

Locality: California, Santa Barbara, Santa Barbara County  
Date: April 4, 1969  
Collector: E. L. Paddock  
Host: Raisins  
Diagnosis: No pathogens found.

6

Locality: Georgia, Tifton, Tift County  
Date: June 26, 1968  
Collector: J. A. Payne  
Host: Unknown  
Diagnosis: *Howardula* sp.

7

Locality: Guerrero, Acapulco de Juarez, Mexico  
Date: October 27, 1967  
Collector: G. T. Okumura  
Host: Coconut  
Diagnosis: *Adelina* sp., *Nosema* sp. (pyriform).

8

Locality: Hawaii, Kona, Hawaii County  
Date: May 18, 1968  
Collector: G. T. Okumura  
Host: Papaya  
Diagnosis: No pathogens found.

9

Locality: Hawaii, Nanakuli, Honolulu County  
Date: May 8, 1968  
Collector: G. T. Okumura  
Host: Cantaloupe  
Diagnosis: *Helicosporidium parasiticum*; *Ophryocystis* sp.

Locality: Mexico, Cuernavaca, Mexico  
 Date: October 27, 1967  
 Collector: G. T. Okumura  
 Host: Pineapple, grapefruit, guava  
 Diagnosis: *Helicosporidium parasiticum*; *Nosema* sp. (pyriform); *Ophryocystis* sp.

## 11

Locality: Mississippi, Stoneville, Washington County  
 Date: September 28, 1967  
 Collector: G. M. Buxton  
 Host: Pear  
 Diagnosis: *Helicosporidium parasiticum*; *Howardula* sp.; *Ophryocystis* sp.

## 12

Locality: Nuevo Leon, Melchor Ocampo, Mexico  
 Date: November 6, 1967  
 Collector: G. T. Okumura  
 Host: Citrus  
 Diagnosis: *Howardula* sp.; *Nosema* sp. (reniform); *Pleistophora* sp.

## 13

Locality: Texas, Bryan, Brazos County  
 Date: August 15, 1968, and August 23, 1968  
 Collector: G. M. Buxton  
 Host: Figs  
 Diagnosis: Cephaline eugregarine; *Howardula* sp.

## 14

Locality: Texas, Calvert, Robertson County  
 Date: August 23, 1968  
 Collector: G. M. Buxton  
 Host: Figs  
 Diagnosis: *Howardula* sp.

## 15

Locality: Texas, College Station, Brazos County  
 Date: August 15, 1968, and August 23, 1968  
 Collector: G. M. Buxton  
 Host: Pears, peaches, watermelon, figs, and crabapple  
 Diagnosis: Cephaline eugregarine; *Crithidia* sp.; entaphelenchid nematode; haplosporidian in Malpighian tubes; *Helicosporidium parasiticum*; *Howardula* sp.; *Ophryocystis* sp.

## 16

Locality: Texas, Greenfield, Johnson County  
 Date: August 26, 1968  
 Collector: G. M. Buxton  
 Host: Persimmon  
 Diagnosis: *Howardula* sp.; *Nosema* sp. (ovoid); *Ophryocystis* sp.

Locality: Vera Cruz, Coatepec, Mexico  
 Date: November 6, 1967  
 Collector: G. T. Okumura  
 Host: Orange  
 Diagnosis: No pathogens found.

## 18

Locality: Vera Cruz, Fortin de las Flores, Mexico  
 Date: October 30, 1967  
 Collector: G. T. Okumura  
 Host: Unknown  
 Diagnosis: *Nosema* sp. (pyriform).

*Carpophilus obsoletus* Erichson

## 1

Locality: California, Clovis, Fresno County  
 Date: April 30, 1968, and July 17, 1968  
 Collector: Laboratory culture  
 Host: Figs  
 Diagnosis: Cephaline eugregarine; *Nosema* sp. (pyriform); *Pleistophora* sp.

*Carpophilus pilosellus* Motschulsky

## 1

Locality: Florida, Gainesville, Alachua County  
 Date: October 26, 1968  
 Collector: G. M. Buxton  
 Host: Squirrel cage debris  
 Diagnosis: Haplosporidian in Malpighian tubes; *Helicosporidium parasiticum*.

*Conotelus stenoides* Murray

## 1

Locality: Georgia, Tifton, Tift County  
 Date: September 12, 1968  
 Collector: J. A. Payne  
 Host: Palm fruit  
 Diagnosis: Cephaline eugregarine; *Helicosporidium parasiticum*.

*Conotelus* sp.

## 1

Locality: Texas, Greenfield, Johnson County  
 Date: August 26, 1968  
 Collector: G. M. Buxton  
 Host: Peaches  
 Diagnosis: *Mattesia* sp.

*Haptoncus luteolus* (Erichson)

## 1

Locality: California, Fresno, Fresno County



Date: January 18, 1967  
Collector: Laboratory culture  
Host: Pears  
Diagnosis: *Nosema* sp. (ovoid).

2

Locality: Texas, Bryan, Brazos County  
Date: August 23, 1968  
Collector: G. M. Buxton  
Host: Pears  
Diagnosis: Cephaline eugregarine.

3

Locality: Texas, College Station, Brazos County  
Date: August 14, 1968  
Collector: G. M. Buxton  
Host: Watermelon  
Diagnosis: Haplosporidian in Malpighian tubes.

4

Locality: Texas, Greenfield, Johnson County  
Date: August 26, 1968  
Collector: G. M. Buxton  
Host: Persimmons  
Diagnosis: No pathogens found.

### *Lobiopa insularis* (Castelnau)

1

Locality: Georgia, Tifton, Tift County  
Date: May 25, 1969  
Collector: J. A. Payne  
Host: Apple  
Diagnosis: No pathogens found.

2

Locality: Texas, Calvert, Robertson County  
Date: August 21, 1968  
Collector: G. M. Buxton  
Host: Figs  
Diagnosis: *Leptomonas* sp.; *Mattesia* sp.

3

Locality: Texas, College Station, Brazos County  
Date: August 14, 1968  
Collector: G. M. Buxton  
Host: Figs  
Diagnosis: Cephaline eugregarine.

4

Locality: Texas, Greenfield, Johnson County  
Date: August 26, 1968  
Collector: G. M. Buxton  
Host: Pears  
Diagnosis: Cephaline eugregarine.

5

Locality: Texas, Weslaco, Hidalgo County  
Date: August 19, 1968  
Collector: G. M. Buxton  
Host: Grapefruit  
Diagnosis: Cephaline eugregarine; *Leptomonas* sp.

### *Stelidota geminata* (Say)

1

Locality: California, Piedra, Fresno County  
Date: October 4, 1968  
Collector: J. Counsilman  
Host: Raisins  
Diagnosis: No pathogens found.

2

Locality: Mississippi, Stoneville, Washington County  
Date: September 28, 1967  
Collector: G. M. Buxton  
Host: Persimmon  
Diagnosis: *Nosema* sp. (ovoid).

3

Locality: Texas, Lored, Webb County  
Date: August 20, 1968  
Collector: G. M. Buxton  
Host: Grapefruit  
Diagnosis: *Helicosporidium parasiticum*;  
*Ophryocystis* sp.

### *Stelidota* sp.

1

Locality: Texas, Roma, Starr County  
Date: August 18, 1968  
Collector: G. M. Buxton  
Host: Grapefruit  
Diagnosis: Cephaline eugregarine; *Helicosporidium parasiticum*.

### *Urophorus humeralis* (Fabricius)

1

Locality: California, Fresno, Fresno County  
Date: August 21, 1966  
Collector: Laboratory culture  
Host: Figs  
Diagnosis: *Mattesia* sp.

2

Locality: California, Sacramento, Sacramento County  
Date: September 6, 1967

Collector: R. F. Wilkey  
Host: Melon  
Diagnosis: Cephaline eugregarine.

3

Locality: Guerrero, Acapulco de Juarez, Mexico  
Date: October 27, 1967  
Collector: G. T. Okumura  
Host: Coconut  
Diagnosis: No pathogens found.

4

Locality: Guerrero, Barrio Pie de la Cuesta, Mexico  
Date: October 30, 1967  
Collector: G. T. Okumura  
Host: Banana  
Diagnosis: *Helicosporidium parasiticum*.

5

Locality: Hawaii, Paho, Hawaii County  
Date: May 17, 1968  
Collector: G. T. Okumura  
Host: Papaya  
Diagnosis: Sphaerulariid nematode.

6

Locality: Hawaii, Nanakuli, Honolulu County  
Date: May 8, 1968  
Collector: G. T. Okumura  
Host: Cantaloupe  
Diagnosis: No pathogens found.

7

Locality: Texas, Roma, Starr County  
Date: August 20, 1968  
Collector: G. M. Buxton  
Host: Grapefruit  
Diagnosis: No pathogens found.

8

Locality: Texas, Weslaco, Hidalgo County  
Date: August 20, 1968  
Collector: G. M. Buxton  
Host: Guava  
Diagnosis: Diplococcoid bacterium.

Steinhaus and Marsh<sup>3</sup> reported two fungi, *Beauveria bassiana* (Bals.) and an *Aspergillus* sp., from the nitidulid *Glischrochilus quadrisignatus* (Say); however, fungi were not observed in the live adult beetles that were examined. The authors found only one bacterium and no viruses; however, protozoa were predominant and occurred in all but one of the host species (table 1). Nematodes were found in one-third of the nitidulid species samples, and, with the exception of one entaphelenchid, they all belonged to the family Sphaerulariidae.

Four pathogens—a host specific sphaerulariid nematode (*Howardula* sp.) and three nonspecific sporozoans (*Helicosporidium parasiticum*, *Pleistophora* sp., and a pyriform *Nosema* sp.)—are being studied for their biological control potential on stored-product insects.

<sup>3</sup>Steinhaus, Edward A., and Marsh, Gordon A. Reports of Diagnoses of Diseased Insects, 1951–1961. *Hilgardia* 33(9):387. 1962

TABLE 1.—Frequency of pathogen occurrence

Pathogens found	Nitidulid species infected		Nitidulid accessions infected	
	Number	Percent <sup>1</sup>	Number	Percent <sup>2</sup>
Protozoa	14	93.3	79	66.9
Kinetoplasida	2	13.3	3	2.5
Eugregarinida	13	86.7	27	22.9
Neogregarinida	8	53.3	38	32.2
Eucoccida	1	6.7	1	.8
Haplosporida	4	26.7	9	7.6
Helicosporida	8	53.3	23	19.5
Microsporida	9	60.0	21	17.8
Nematoda (Tylenchida)	5	33.3	25	21.2
Total number infected	14	93.3	90	76.3

<sup>1</sup>Of 15 nitidulid species.

<sup>2</sup>118 accessions of nitidulid beetles were examined.

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